Agrometeorologists for farmers in hotter, drier, wetter future

Nov. 9, 2016, Ljubljana

FAO perspectives:

From climate information to climate impacts on agriculture and food security

Mariko Fujisawa

FAO - Climate and Environment Division
(Mariko.Fujisawa@fao.org)

Some examples of FAO Works in Agrometeorology

Supporting countries by…

Analysis and tools for the longer term: (policy making)

1. Investigating the weather indices which define agricultural practices (seeing the past towards future)
2. Longer term impact assessment of climate change on agriculture (seeing towards future)

Practical Operations: (technical operation on ground)

3. Drought monitoring (seeing the current)
4. Support to produce the information for farming practices (e.g. agricultural bulletin)

LONGER TERM ANALYSIS:

1. WEATHER INDEX
2. IMPACT ASSESSMENT

1 &2 Weather Indices and Impact Assessment on Agriculture

Used for implementing the projects for CSA (Climate Smart Agriculture) and NAP (National Adaptation Plans)

- Any CSA projects should be supported by robust evidences.
- Evidence about what have been happening to climate and agriculture in the country
- Evidence about what is expected to happen in the future:

→ Support to strengthen the evidence-base

→ Different methodologies/approaches/models for strengthening each evidence by country ownership

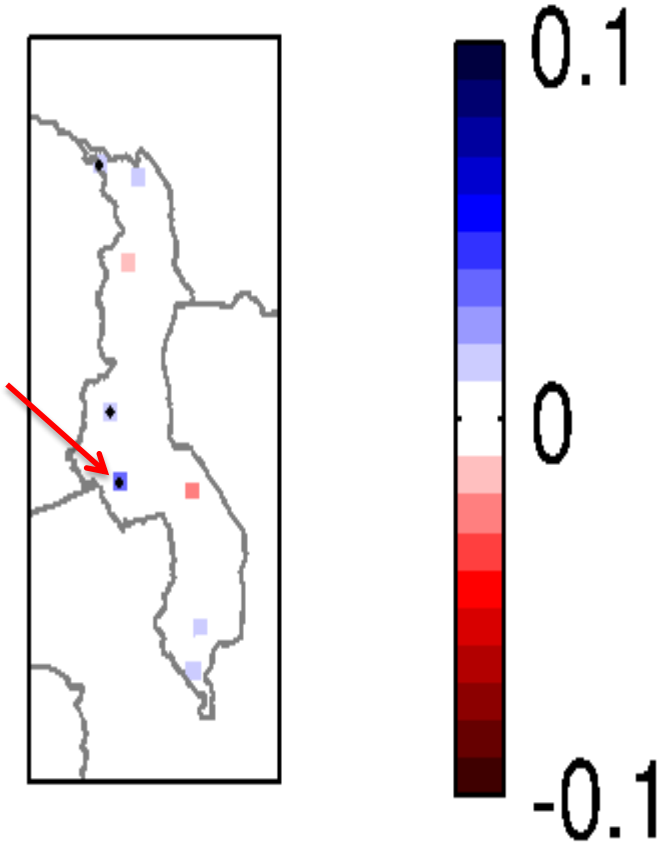
→ We support their capacity building

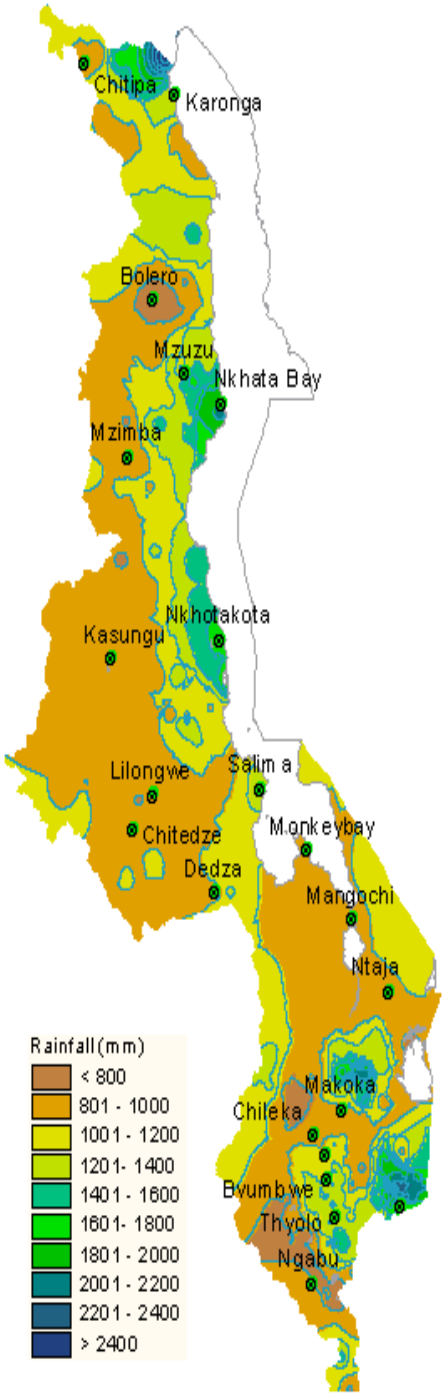
1. Some examples of Weather Indices

In the context where water usage is the main limiting factor for plant growing

General	Agriculture-centric	Crop specific
Annual average rainfall	Length of potential growing season	Planting date
Monthly average rainfall	Number of rain events in season	Dry spells during reproductive period
Monthly average temperature	Temperature requirement fulfilled	Growing stage of a crop
Monthly average T_{max} / T_{min}	Occurrence of extreme temperature	Temperature (hot/ cold) damage on crop

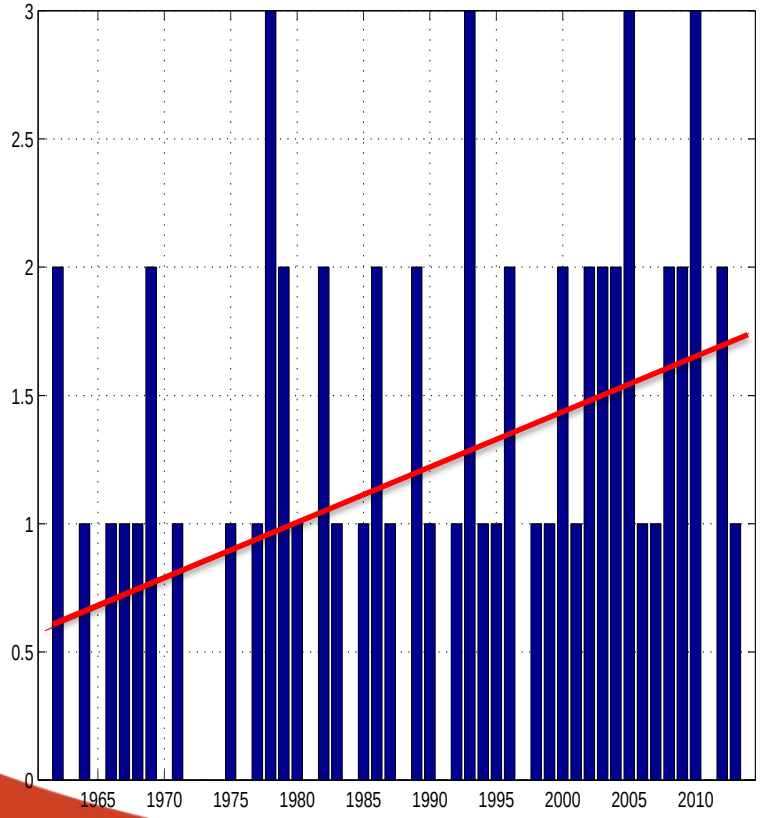
1. Weather Indices: Dry spells during Maize production period in Malawi



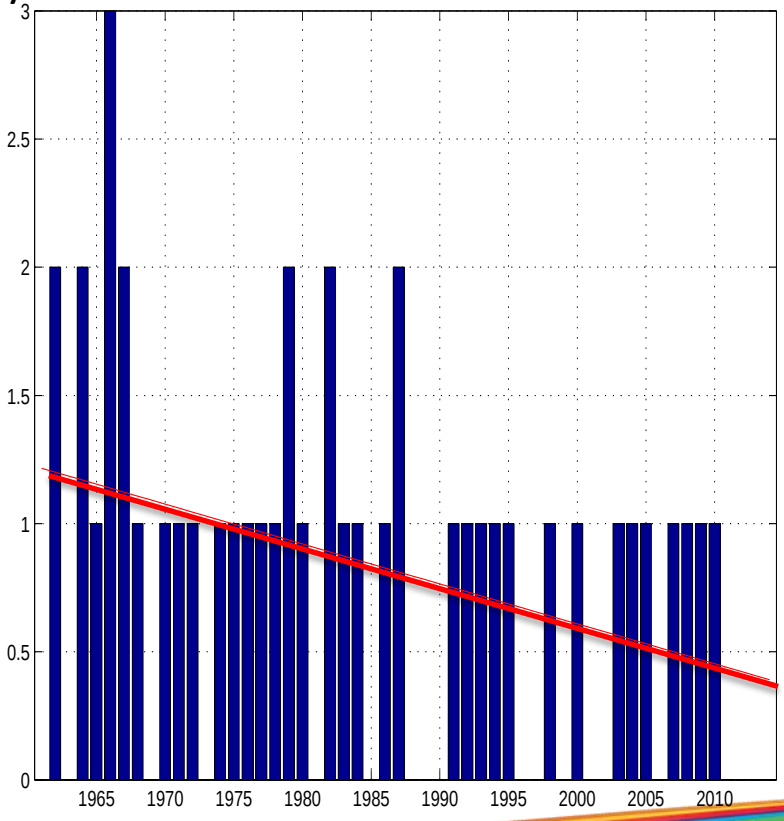


Dry-spell in Chitedze, Malawi

Number of dry-spells during the reproductive period of the 120-day and 90-day Maize



120-day Maize



90-day Maize

Some examples of Indices defined

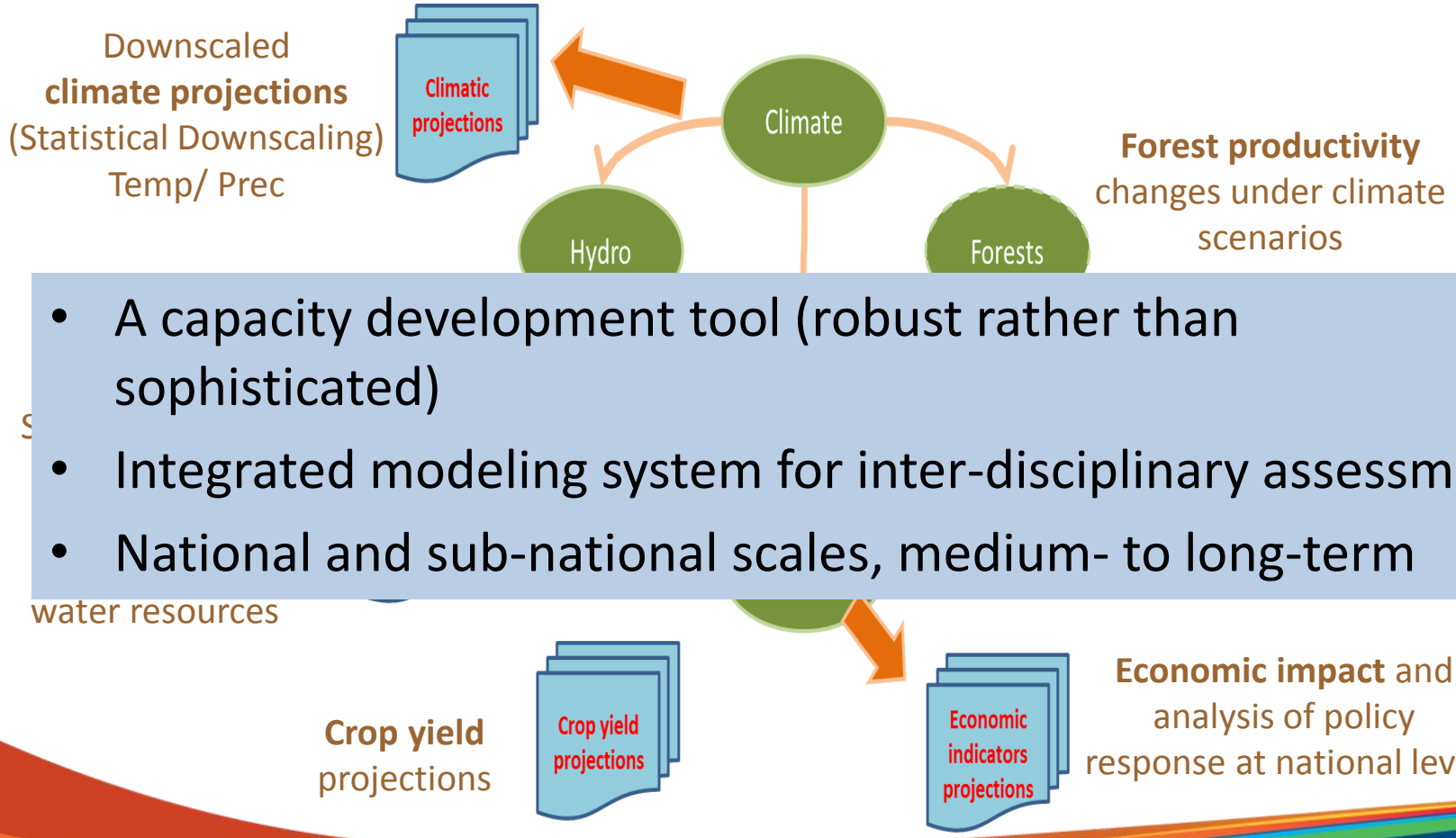
In the context where water usage is the main limiting factor for plant growing

Index Name	Definition
Initial Planting date (Maize)	Date of start of any period (between 01-Oct and 15-Mar) when crop-specific planting conditions are met (a first day with Pr > 20mm)
Dry-spells during reproductive period	Any period of 5 or more days with Pr < 2.5mm per day between days 61 and 90 after final planting date

- Try to get better understanding of Weather-Agriculture relationship and trend in the past

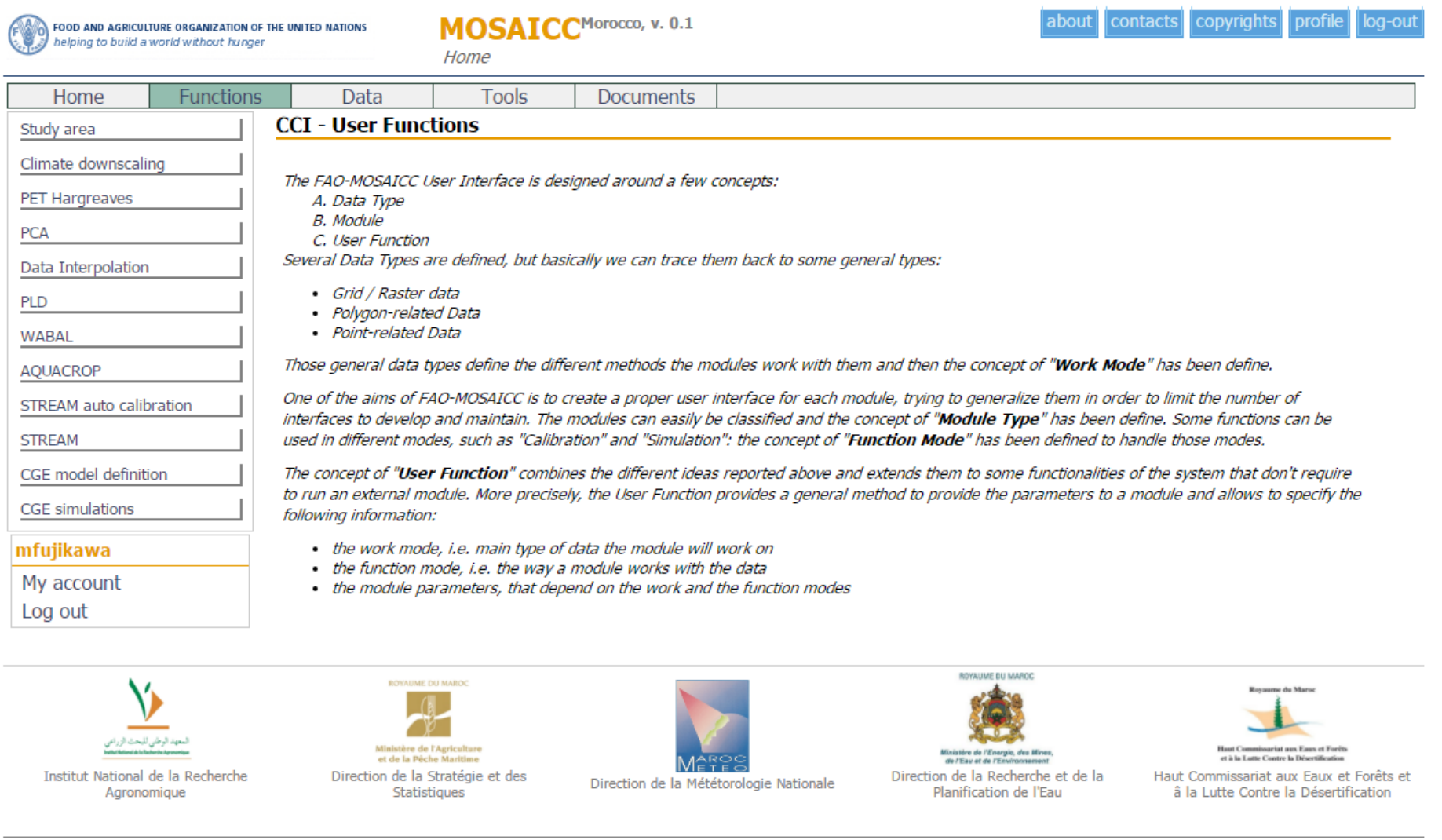
2. Impact Assessment : MOSAICC

(Modelling System for Agricultural Impacts of Climate Change)



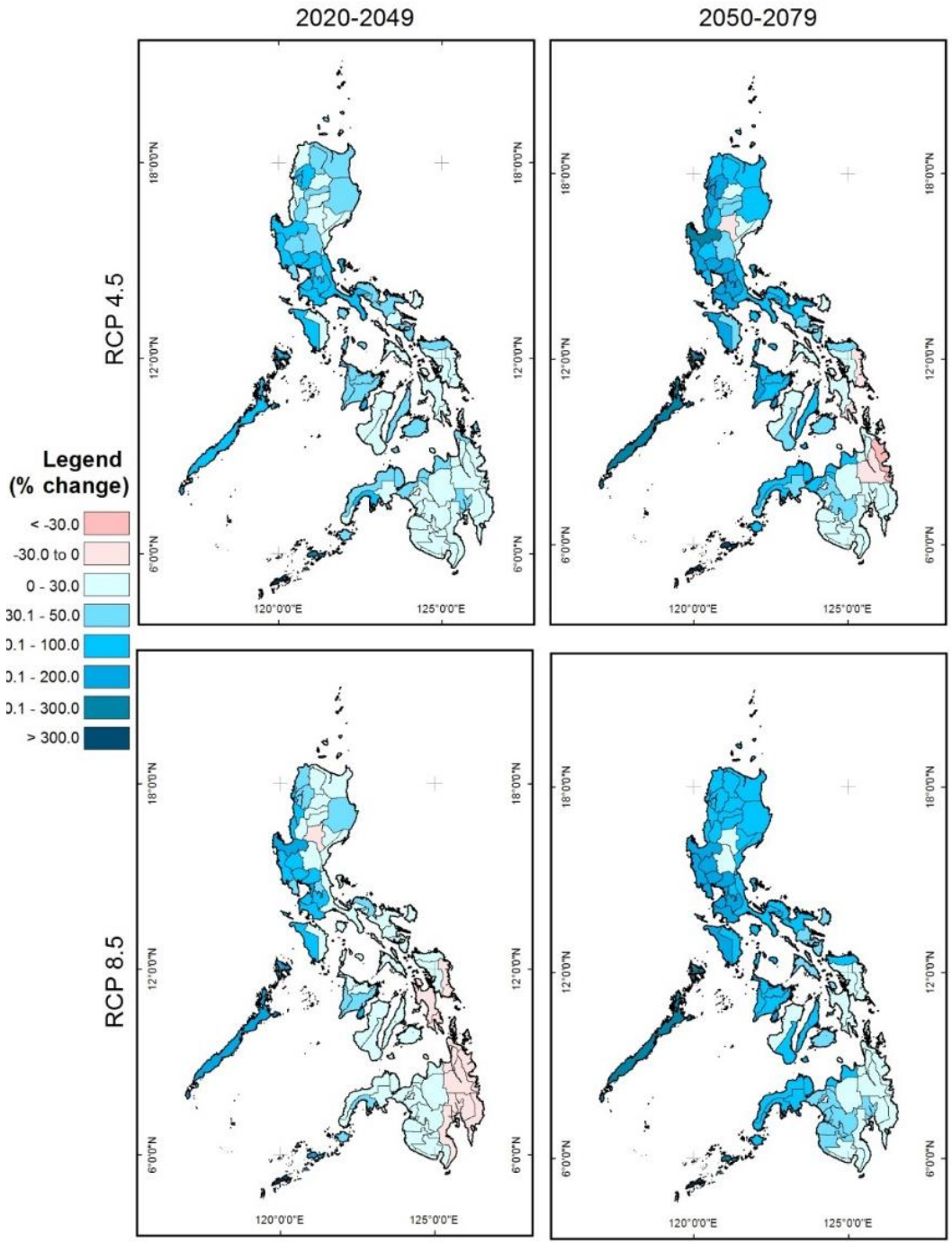
- A capacity development tool (robust rather than sophisticated)
- Integrated modeling system for inter-disciplinary assessments
- National and sub-national scales, medium- to long-term

2. MOSAICC portal



Rainfall projection: 2020-2049 vs 2050-2079 (Dec to Feb)

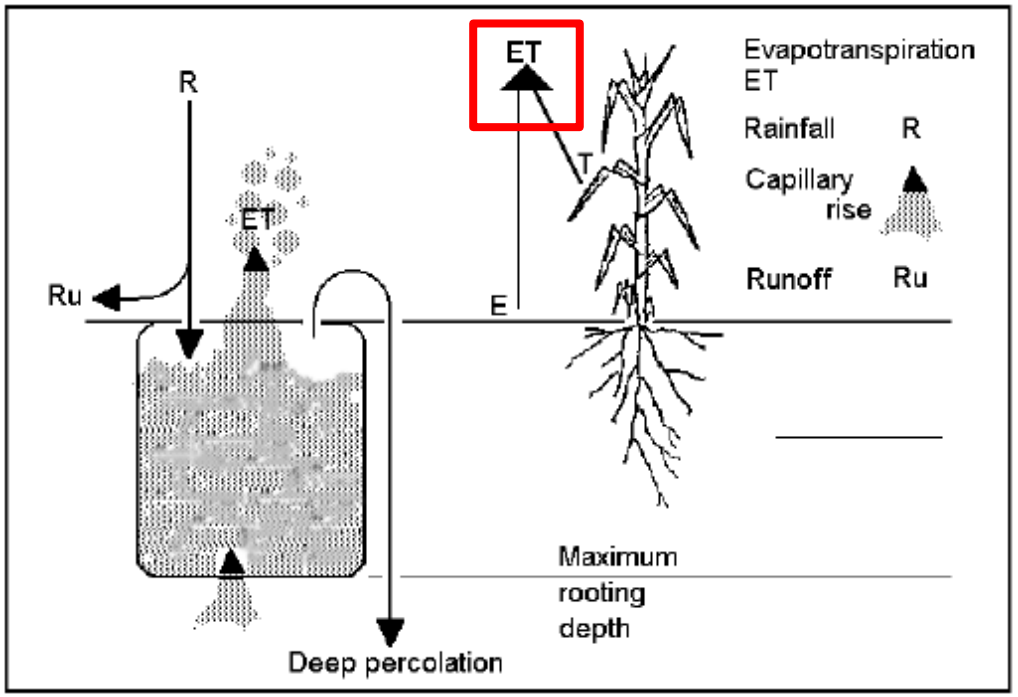
National scale with sub-national disaggregation



MOSAICC: Crop Models

WABAL

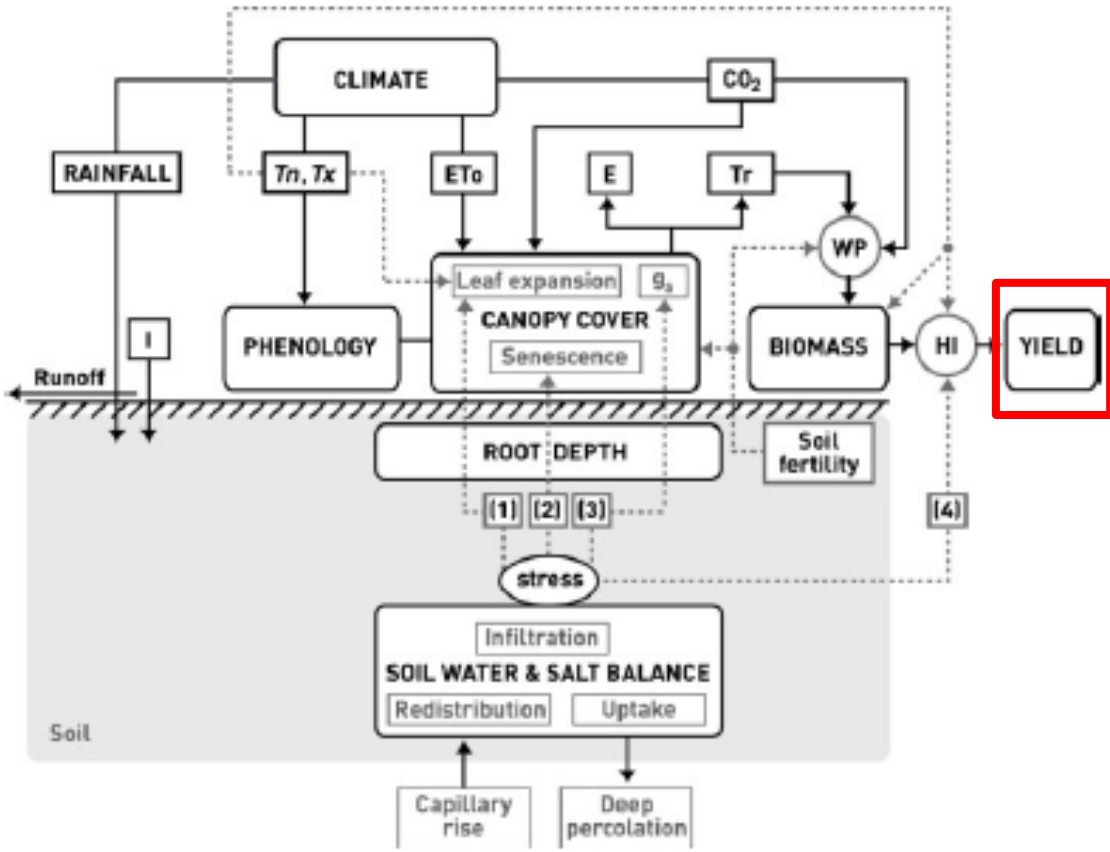
- Crop specific water balance model (=Agrometshell) the FAO crop forecasting tool
- Used to produce crop water balance variables
- Need to get the historical yield data
- Make the yield function (correlation with historical yield data)



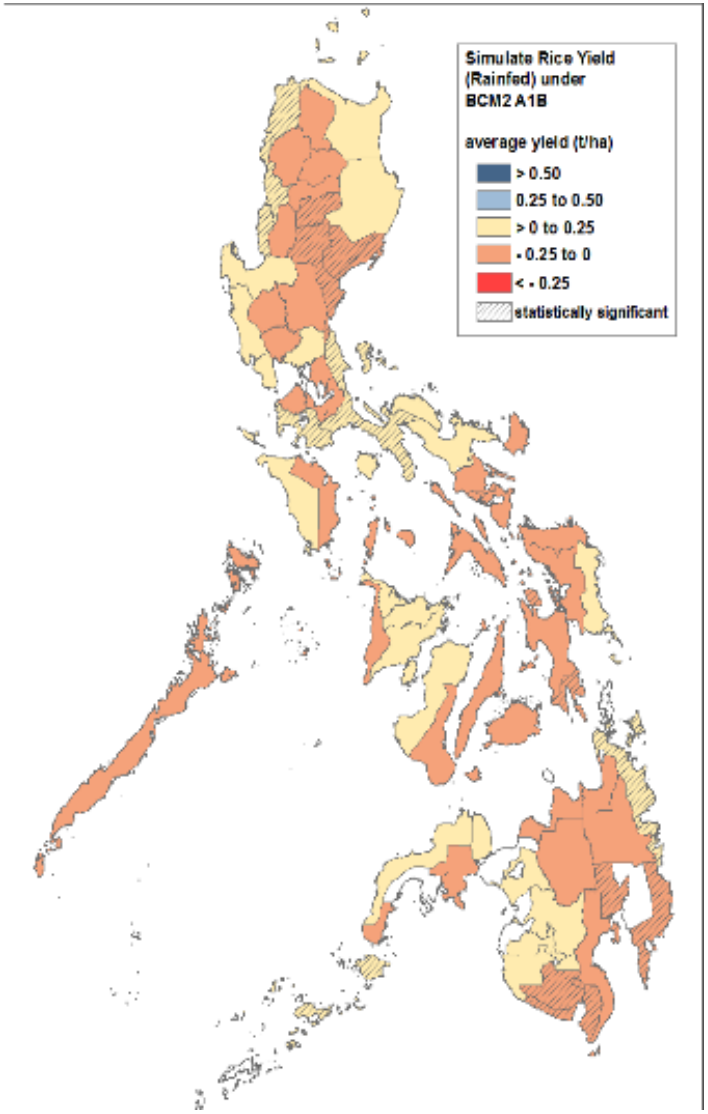
MOSAICC: Crop Models

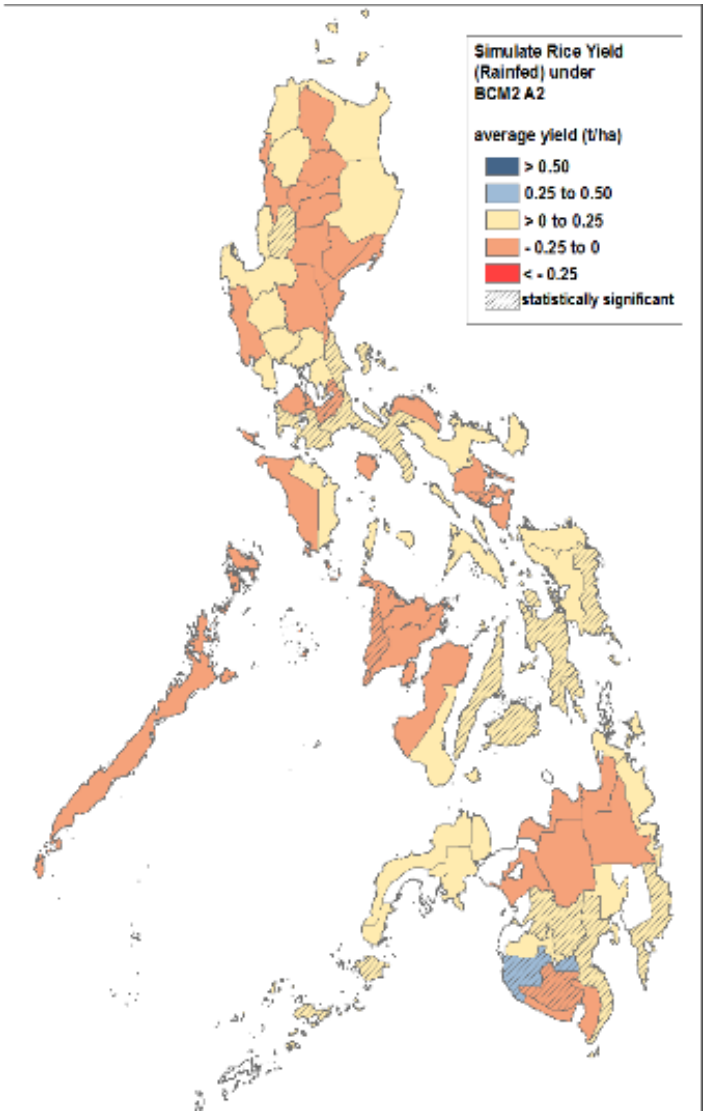
AQUACROP:

- FAO crop-model to simulate yield response to water
- Used to produce crop yield projections under climate scenarios
- Main Crops: wheat, maize, rice, sugarbeet, soybean, cotton, potato, quinoa, sunflower, bambara groundnut, sugarcane, Tomato, teff, barley, sorghum



Rainfed rice yield change: 2011-2040 vs 1971-2000





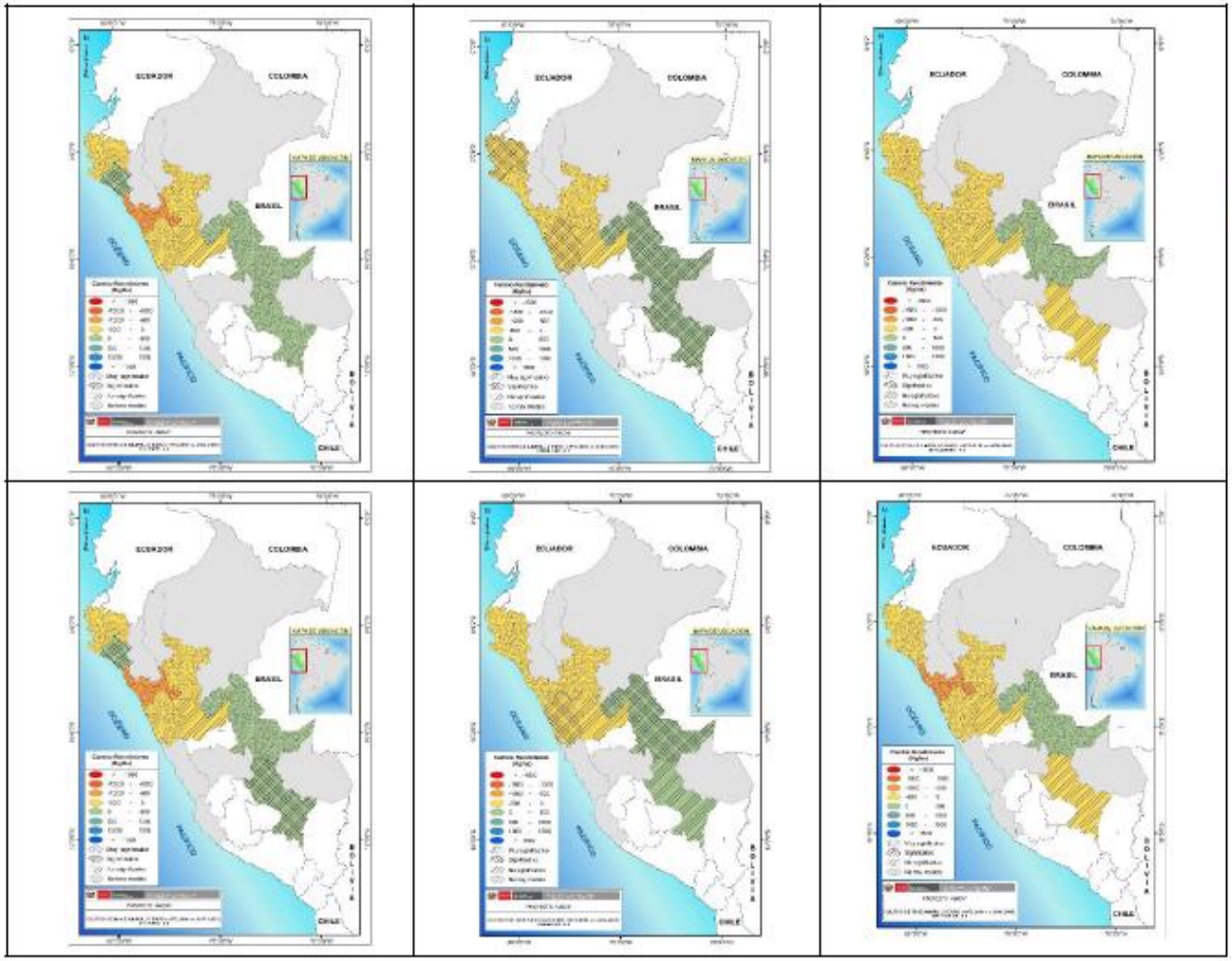
Maize yield change in Peru: 2036-2065 vs 1971-2000

Senamhi

Cultivo de maíz amarillo duro

Cambio Rendimiento (Kg/ha)	
< -1500	
-1500 - -1000	
-1000 - -500	
-500 - 0	
0 - 500	
500 - 1000	
1000 - 1500	
> 1500	
Muy significativo	
Significativo	
No significativo	
No hay modelo	

CanESM2 | **CNRM-CM5** | **MPI-ESM-MR**



RCP 4.5

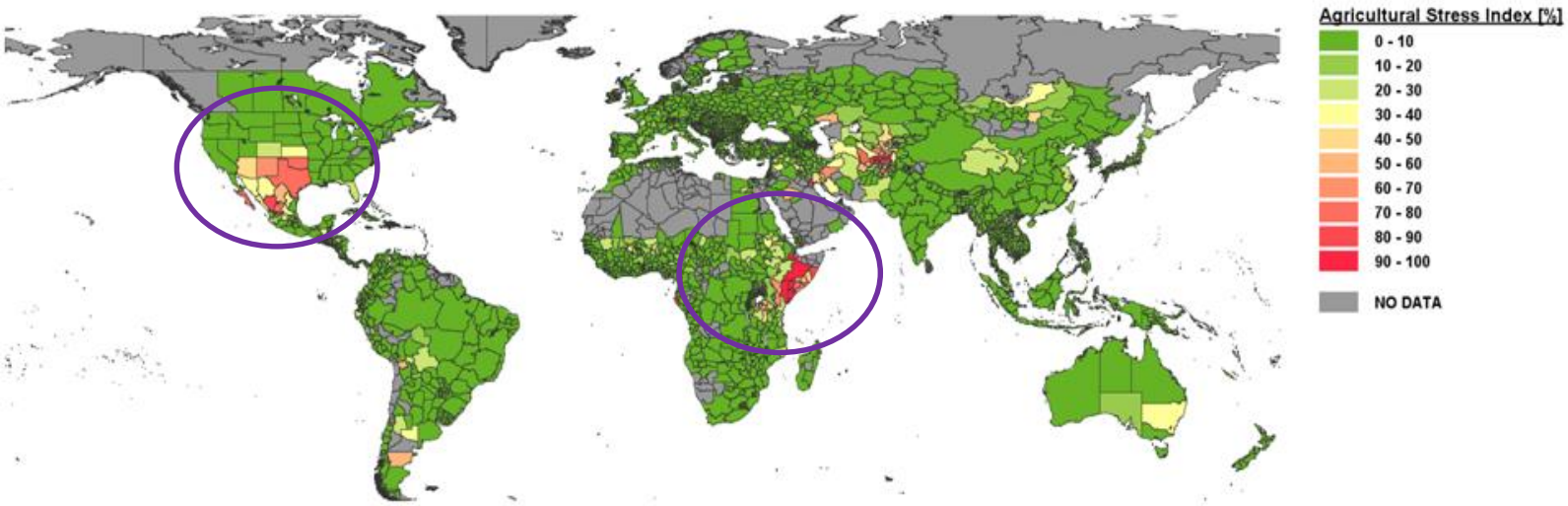
RCP 8.5

PRACTICAL OPERATION:
3. DROUGHT MONITORING
4. OTHER SUPPORTS

3. Drought monitoring tool: ASIS

- ASIS: Agriculture Stress Index System

Main agricultural drought hot spots in **2011 United States**, **Mexico** and the **Horn of Africa**.



http://www.fao.org/giews/earthobservation/index.jsp?lang=en

Food and Agriculture Organization of the United Nations

Google™ Custom Search

About FAO | In Action | Countries | Themes | Media | Publications | Statistics | Partnerships

العربية 中文 English Français Русский Español

Earth Observation

GIEWS

Seasonal Global Indicators | Global Indicators | Country Indicators | Partners | Reference

The seasonal indicators are designed to allow easy identification of areas of cropped land with a high likelihood of water stress (drought). The indices are based on remote sensing data of vegetation and land surface temperature combined with information on agricultural cropping cycles derived from historical data, and a global crop mask. The final maps highlight anomalous vegetation growth, and potential drought, in crop zones during the growing season. ⊞ More

Near Real Time (10 days) | Annual Summary | Crop Growing Season

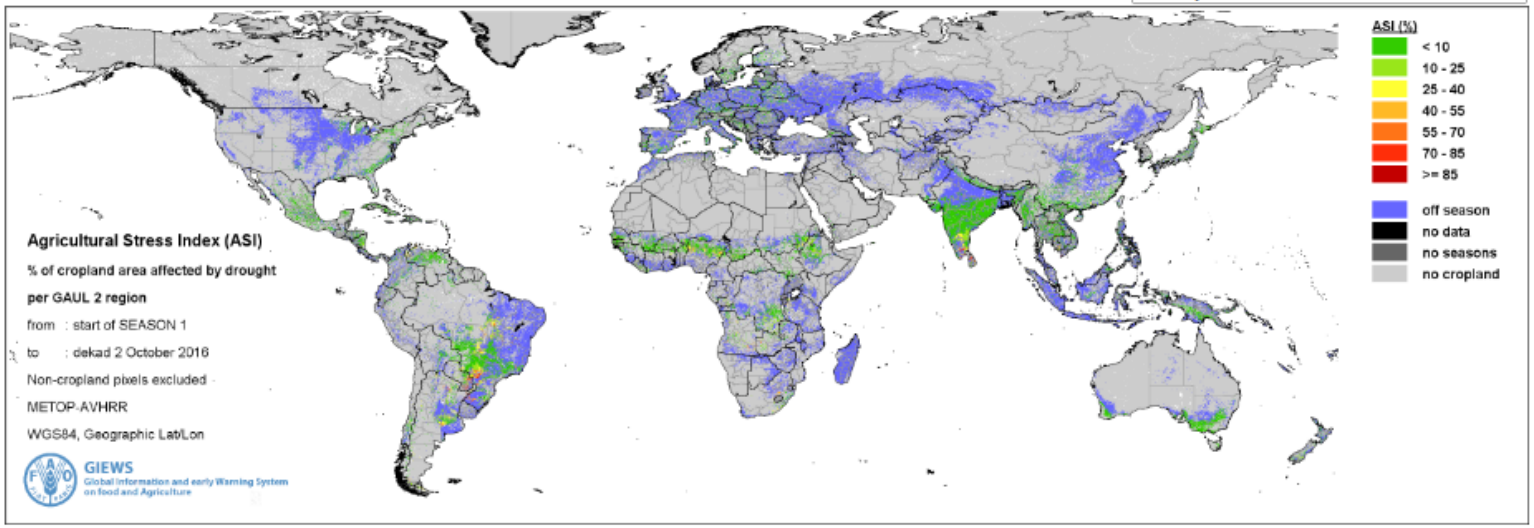
Season 1 | Season 2

Year Dekad

Select: 2016 ▼ 2 Oct ▼ <--- ---> Slideshow ▷

Agricultural Stress Index ⊞ More

Country level: ▼



ASIS (Agricultural Stress Index System) is based on VHI (Vegetation Health Index)

Vegetation condition index (VCI)

$$VCI_i = \frac{NDVI_i - NDVI_{\min}}{NDVI_{max} - NDVI_{min}}$$

Temperature condition index (TCI)

$$TCI_i = \frac{BT_{max} - BT_i}{BT_{max} - BT_{min}}$$

Vegetation Health Index (VHI)

VHI = a*VCI + (1-a)* TCI

low VHI

high VHI

VHI<35
Drought

Agricultural Stress Index (ASI)

Mean VHI image over the crop season

0,07	0,24	0,33	0,18	0,34	0,10	0,34	0,54	0,06	0,66
0,29	0,23	0,01	0,27	0,34	0,32	0,57	0,6	0,25	0,05
0,24	0,30	0,21	0,21	0,22	0,17	0,52	0,43	0,16	0,45
0,31	0,16	0,03	0,07	0,03	0,06	0,37	0,46	0,25	0,76
0,26	0,19	0,34	0,16	0,09	0,03	0,44	0,50	0,50	0,42
0,39	0,27	0,34	0,07	0,07	0,35	0,26	0,50	0,45	0,60
0,38	0,48	0,30	0,26	0,21	0,28	0,69	0,44	0,51	0,58
0,40	0,60	0,41	0,48	0,57	0,43	0,54	0,59	0,50	0,46
0,50	0,52	0,51	0,57	0,52	0,51	0,45	0,54	0,58	0,54
0,43	0,44	0,56	0,46	0,52	0,46	0,46	0,48	0,56	0,55

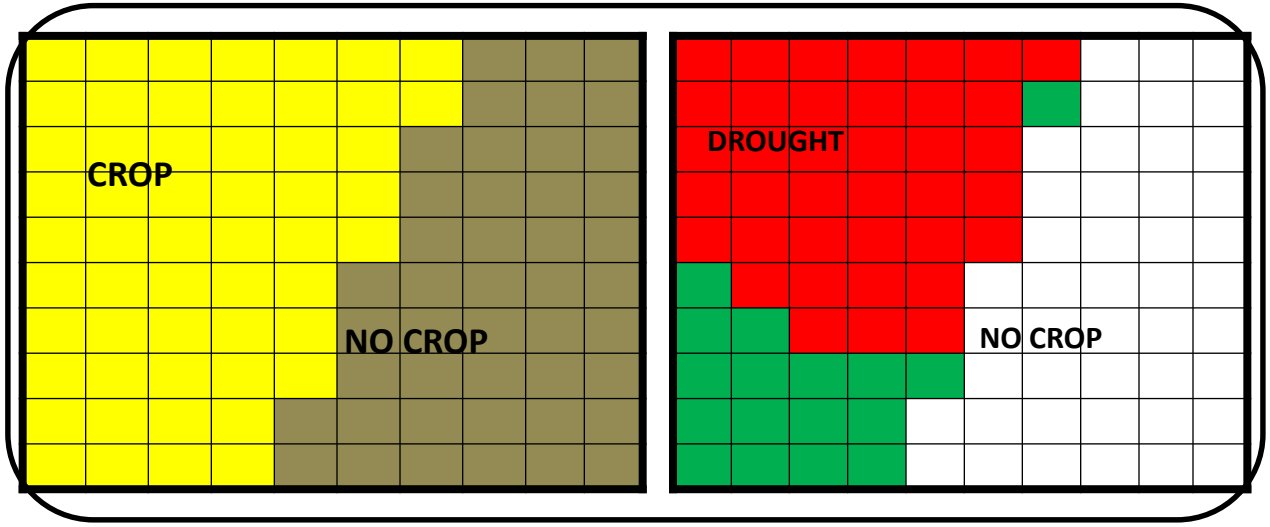
(1)

THRESHOLD

PIXELS with MEAN VHI < 35%

0,07	**0,24**	**0,33**	**0,18**	**0,34**	**0,10**	**0,34**	0,54	**0,06**	0,66
0,29	**DROUGHT**			**0,34**	**0,32**	0,57	0,60	**0,25**	**0,05**
0,24	**0,3**	**0,21**	**0,21**	**0,22**	**0,17**	0,52	0,43	**0,16**	0,45
0,31	**0,16**	**0,03**	**0,07**	**0,03**	**0,06**	0,37	0,46	**0,25**	0,76
0,26	**0,19**	**0,34**	**0,16**	**0,29**	**0,03**	0,44	0,50	0,50	0,42
0,39	**0,27**	**0,34**	**0,07**	**0,07**	**0,34**	**0,26**	0,50	0,45	0,60
0,38	0,48	**0,3**	**0,26**	**0,21**	**0,28**	0,69	0,44	0,51	0,58
0,40	0,60	0,41	0,48	0,57	0,43	0,54	0,59	0,50	0,46
0,50	0,52	0,51	0,57	0,52	0,51	0,45	0,54	0,58	0,54
0,43	0,44	0,56	0,46	0,52	0,46	0,46	0,48	0,56	0,55

(2) **ONLY CROP AREA**



(3) **PIXEL COUNTING**

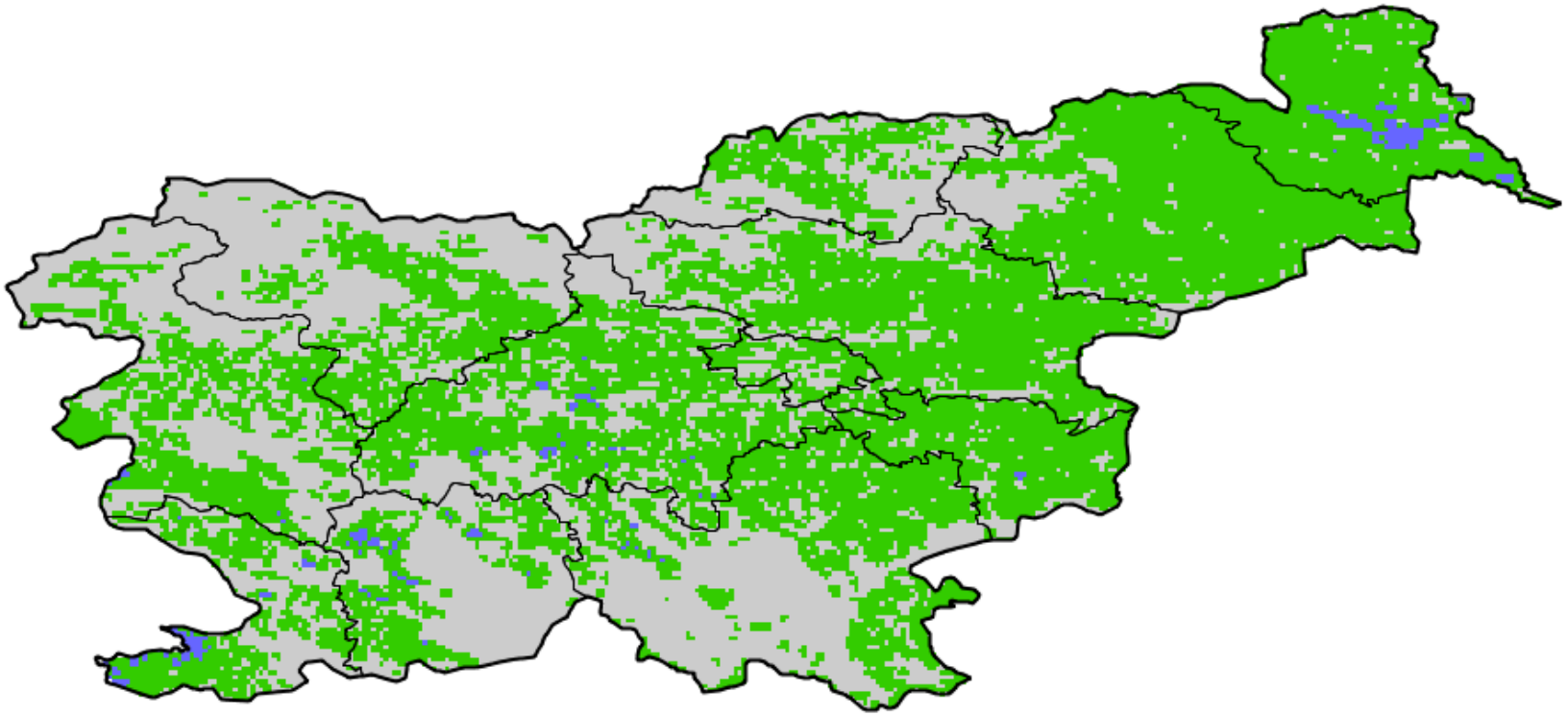
ASI

% of **crop area** affected by drought

$$\frac{\#\text{drought pixels (38)}}{\#\text{total crop pixels (55)}}$$

= ± 70%

Slovenia



Agricultural Stress Index (ASI)

% of cropland area affected by drought

per GAUL 2 region

from : start of SEASON 1

to : dekad 1 September 2016

Non-cropland pixels excluded

METOP-AVHRR

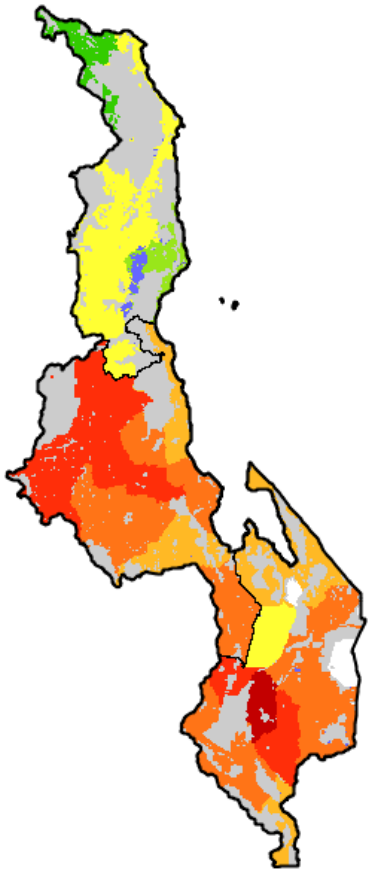
WGS84, Geographic Lat/Lon

ASI (%)

- < 10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 70 - 85
- >= 85
- off season
- no data
- no seasons
- no cropland

FAO FIAT PANIS GIEWS

Malawi



Agricultural Stress Index (ASI)

% of cropland area affected by drought

per GAUL 2 region

from : start of SEASON 1

to : dekad 1 January 2016

Non-cropland pixels excluded

METOP-AVHRR

WGS84, Geographic Lat/Lon

ASI (%)

- < 10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 70 - 85
- >= 85
- off season
- no data
- no seasons
- no cropland

GIEWS

4. Support for practical operations Case: Macedonia

- Support Hydrometeorological Division to produce climatic information for farmers
  - Install AWSs to strengthen climate data collection (cover the whole country) for forecast
  - Set up the database for climate and phenology
  - Develop pest/ disease model base on the climate data

  -> Produce agromet bulletin to support farmers (climate, phenology, pest/disease)
  - Calculate crop-specific soil-water balance (Agrometshell)
  - Crop Yield forecasting (Agrometshell)
  - Estimate crop yield (Aquacrop)
  - Crop insurance (ASIS)
  - Seasonal forecast/ pest and disease information (outside source)

Conclusion

- Identify the country's needs and capacity/ information gaps
- Choose methodology that can fill the gaps
- Data availability and quality – lack of data can be complemented by global dataset (to some extent)
- MOSAICC and Weather Index: CSA, NAP etc., implemented in Morocco, the Philippines, Peru, (ongoing) Malawi, Zambia, Paraguay, Indonesia
- ASIS: Vietnam, Lao PDR, etc.
- Practical operations: Georgia, Macedonia, Namibia, Tajikistan, (Central Asia)

Conclusion

- We are open to support countries with other requests
- We are open to develop other new methods

- If you are interested in working with us, let us know!

Thank you!